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ABSTRACT

This study investigated whether the interaction of teacher, student, and classroom characteristics has a significant effect on classroom climate. Linear regression techniques were used to predict selected scales of "Anderson's Learning Environment Inventory" (LEI) from sets of orthogonal variables which are representative characteristics of the teacher, student group, and class structure. Eight scales accounted for 21-53 percent of the variance for the model group of 72 classes. Data for the study were drawn from the Harvard Project Physics Summative Evaluation Data Bank which represents a true national random sample of 54 physics teachers with 3,085 students in 103 classes. (Author/MLH)

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PREDICTING LEARNING ENVIRONMENTS FROM TEACHER AND STUDENT PERSONALITY

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PREDICTING LEARNING ENVIRONMENTS FROM TEACHER AND STUDENT PERSONALITY

A persistent intuitive belief exists among educators that the interaction of teacher, student and classroom characteristics has a significant effect on classroom climate. Anderson's Learning Environment Inventory (LEI)[1] provides more than a dozen measures of classroom climate such as "intimacy", "formality", "goal direction", "disorganization", and "difficulty". In 1967-68 the Harvard Project Physics (HPP) summative evaluation gathered a wide range of data on the characteristics of students, teachers, and classroom climate for use in general education research as well as the specific evaluation of the curriculum under development.[2] Although over sixty research projects have used this data, no studies have utilized the national data to examine the relationship between teacher, student, and classroom characteristics and the resultant classroom climate. This question is addressed by using linear regression techniques to predict selected scales of the Learning Environment Inventory from sets of orthogonal variables which are representative characteristics of the teacher, student group, and class structure. Since the HPP data represents a true national random sample of 54 physics teachers with 3085 students in 103 classes[3], the results of this study can be generalized with some confidence to the universe of physics teachers and classes in the United States.

Related Literature

Previous studies have demonstrated the capability of current personality instruments to distinguish science from non-science

teachers,[4 & 5] teachers who accept or reject innovative science curricula,[6 & 7] and groups of "influential" science teachers, "regular" science teachers, and science research students.[8] The problem of establishing the effects of teacher and student personality on the classroom is more complex.

Walberg[9] conducted a canonical correlation study of "Teacher Personality and Classroom Climate" using 36 male teachers who were selected for the 1966-67 pilot study of HPP. Although the Walberg study supports the plausibility of predicting classroom climate from parameters such as teacher personality, the results are limited by several factors: 1) the teachers in the sample were known to be atypical of physics teachers in general;[10,11] 2) the instrument used to measure classroom climate was later extensively modified to produce the Learning Environment Inventory; 3) the study contained a large number of variables which might have been made more parsimonious and orthogonal through factor analytic techniques; and 4) the effects of student characteristics were not included.

A Sociopsychological Classroom Model

The classroom climate measures used in this study varied as much as three standard deviations among several classes taught by the same teacher. This suggests that efforts to predict classroom climate should not be restricted to teacher characteristics. In this analysis the classroom group is represented by three components -- the teacher, the student group, and the structure of classroom activities -- which are assumed to interact to produce the classroom climate as represented

in Figure 1. The class was chosen as the unit of analysis.

Insert Figure 1 about here

The HPP data bank provided a rich and diverse set of 70 variables from which to choose. The Learning Environment Inventory (LEI) was selected as the criterion measure of classroom climate. A summary of the initial set of independent variables used in the study is provided in Table 1. A detailed description of these variables is presented elsewhere.[12] Because of the empirical nature of the study, an effort

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Insert Table I about here

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was made to develop reasonably orthogonal sets of variables describing each of the major classroom components. This approach minimizes redundancy and produces a more parsimonious model. Several highly correlated scales were combined in the final sets of orthogonal variables.

Choosing Orthogonal Sets of Variables

Table II presents the final sets of orthogonal variables used in the regression model. The relationship of these variables to the

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Insert Table II about here

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original HPP data is described below.

Teacher Variable Set (TCH) A series of three factor analyses reduced the number of teacher variables from eighteen to nine. The highest correlation between any two scales is 0.47. A principal

components factor analysis shows a maximum common variance of 24% for all nine scales, and a varimax rotation suggests that an orthogonal factor space exists which accounts for between 87% to 95% of the variance of each scale with a maximum cross loading of less than 7%. The ATTITUDE-Physics scale was created by taking the mean z-scores on the semantic differential scales PHYSICS-Interesting, Important, Safe. Two other scales were created. POS (Ach+Order+Affil) is the mean z-score for Need-Achievement, Need-Order, and Need-Affiliation. It is assumed to represent a "teacher syndrome" since a different cluster of Need scales was observed for students. This combination of scales appeared justified in the light of the nature of teaching. To a large degree, the recognition of achievement in classroom teaching comes from the teacher's local peers suggesting the relationship between Need-Achievement and Need-Affiliation. The association of Need-Order reflects the nature of most traditional schools in which the teacher is expected to maintain discipline, records, and equipment. The AVL (Aesthetic+Political) scale represents a dipolar dimension which was created by subtracting the z-score for Political Value from the z-score for the Aesthetic Value and dividing by two. The justification for combining these scales is largely empirical ($r = -0.77$); however, considering the ipsative nature of the AVL it is plausible that teachers who have limited opportunity to achieve the "personal power, influence, and renown" associated with the Political scale would emphasize the usual negative correlation between these two scales.

Student Variable Set (STU & VAR) The HPP evaluation group used a novel testing schedule which allowed the administration of a variety of instruments in only three class sessions.[3] Since random half samples

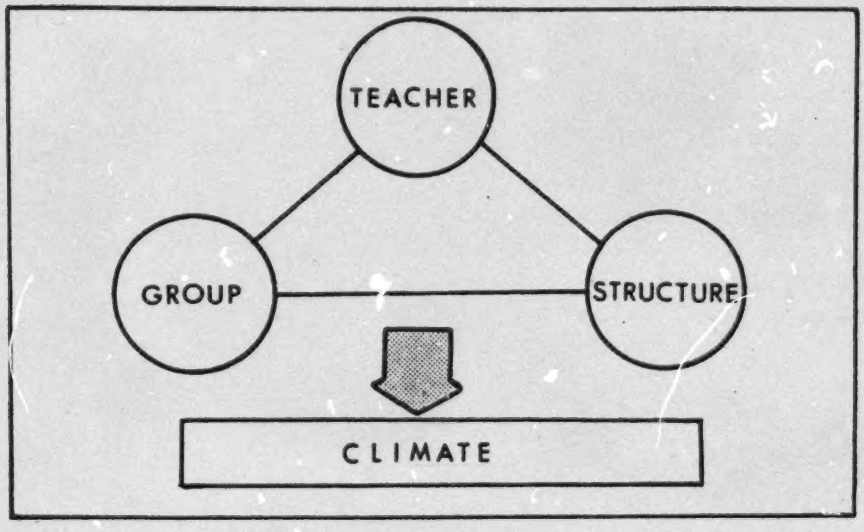

Figure 1. Interaction among the characteristics of the teacher, student group, and class structure influence classroom climate. Orthogonal sets of representative variables which were selected for each of these four components of the learning group are presented in Table II.

TABLE I - Summary of Initial Variable Set

Symbol	Scale Name	Reliability	Comments
SD	Semantic Differential		In-house instrument developed by Geis[16] in a two year study which included trial-testing.
	PHYSICS-Interesting	.86	
	-Important		
	-Safe	.64	
	-Complicated		
	-Valuable	.78	
	-Easy	.77	
	-Orderly		
	-Understandable		
AIM	Academic Interest Measure		Developed by Halpern[17] to measure the subject matter interests of high school students in 6 subjects: Biology, English, Fine Arts, Mathematics, Social Studies and Physical Science.
	Physical Science Scale	.93	
PAI	Pupil Activity Inventory	.90	In-house instrument developed from the Read Science Activity Inventory[18] to provide an operational measure of science interests by tabulating the frequency of voluntary participation in 16 scientific activities during the past year.
SQ	Student Questionnaire	.70	Part 3 of the HPP Student Questionnaire contains several questions selected from the Biographical Inventory (Form M, Institute of Behavioral Research in Creativity, 1966) which relate of student's interest in school, serious study, leadership, etc. Scales created by factor analysis.
	Leader	.46	
	Scholar	.46	
	Opportunity	.42	
	Achiever	.15	
IQ	Hannon-Nelson Test of Mental Abilities	.91	Form B (revised edition). Houghton-Mifflin, 1957.
AVL	Allport-Vernon-Lindsey Study of Values		Houghton-Mifflin, 1960.
	Theoretical	.84	
	Economic	.93	
	Aesthetic	.89	
	Social	.90	
	Political	.87	
	Religious	.95	
POS	Personal Opinion Survey		In-house instrument based on several existing scales. Intended to characterize groups, not provide individual student personality profiles. Published norms do not apply. "Dogmatism" included 24 items from Rokeach Dogmatism Scale.[19] "Rigidity": 15 items rewritten from Gough-Sanford Rigidity Scale.[20] "Authoritarianism": 15 items from California F Scale.[21] Needs scales created from respective scales on the Edwards Personal Preference Schedule.[22 & 23]
	Dogmatism	.65	
	Rigidity	.69	
	Authoritarianism	.68	
	Need-Achievement	.78	
	Need-Order	.82	
	Need-Affiliation	.84	
	Need-Change	.75	
TSTP	Test on Selected Topics in Physics	---	In-house instrument administered only to teachers. Found to be highly correlated with AVL-Theoretical.
TA	Teaching Approach		The HPP Teacher Questionnaire (Part I) contains 20 statements about teaching. A factor analysis produced six factors accounting for 61% of the variance. Five of these factors appeared useful for describing various approaches to teaching.
	"Drudge"	.72	
	Enquiry Modal	.68	
	Hard Core Physics	.64	
	General Education	.64	
	Educator vs Physicist	.42	
TM	Teaching Method		The second part of the HPP Teacher Questionnaire asked teachers to rate 13 teaching activities such as "lecture", "field trips", etc. as "very useful" to "of little use". A factor analysis produced six factors which account for 72% of the variance. Five of these factors appeared useful for describing various kinds of activities which would be expected to be found in these teachers classes.
	Novel	.72	
	Traditional	.52	
	Rigorous	.36	
	Anti-assigned Work	.45	
	Discussion (single item)	---	
LEI	Learning Environment Inventory		The LEI represents a major developmental effort by the HPP evaluation group. An extensive description of the instrument and related research is available from Anderson.[1]
	Cohesiveness	.78	
	Diversity	.58	
	Formality	.64	
	Speed	.77	
	Environment	.65	
	Friction	.78	
	Goal Direction	.86	
	Favoritism	.77	
	Difficulty	.66	
	Apathy	.83	
	Democratic	.67	
	Cliqueness	.74	
	Satisfaction	.80	
	Disorganization	.81	
	Miscellaneous Variables		
	Size of Grade 12		
	Class Size		
	% Female		

TABLE II - Final Sets of Orthogonal Variables

Symbol	Name	Correlations								
Teacher Variable Set (TCH)		1	2	3	4	5	6	7	8	9
TCH(1)	TCH-Theoretical (AVL)	----								
TCH(2)	TCH-Economic (AVL)	-.06	----							
TCH(3)	TCH-Aesthetic+Political (AVL)	-.13	.28	----						
TCH(4)	TCH-Social (AVL)	.07	.13	-.11	----					
TCH(5)	TCH-Religious (AVL)	.11	-.13	.27	-.35	----				
TCH(6)	TCH-Authoritarianism (POS)	-.47	-.05	.08	-.32	-.01	----			
TCH(7)	TCH-Ach+Order+Affil (POS)	-.09	-.04	-.20	.08	-.27	.28	----		
TCH(8)	TCH-Change (POS)	.05	.21	.05	.41	-.01	-.23	.26	----	
TCH(9)	TCH-Attitude Physics (SD)	.04	.18	-.10	.27	-.21	-.14	.08	.40	----
Student Variable Set (STU) Note: VAR variables represent the variance for the respective STU variables										
STU(1)	STU-Attitude Physics (AIM, SD)	----								
STU(2)	STU-IQ (Henmon-Nelson)	.04	----							
STU(3)	STU-Theoretical (AVL)	.14	.09	----						
STU(4)	STU-Aesthetic (AVL)	-.02	.04	-.19	----					
STU(5)	STU-Political (AVL)	-.04	.02	.00	-.23	----				
STU(6)	STU-Auth+Order (POS)	-.01	-.06	-.04	-.11	.02	----			
STU(7)	STU-Ach+Affil+Change (POS)	.05	.01	-.04	.01	.02	.34	----		
STU(8)	STU-School (SQ)	.13	.20	.06	.06	-.02	.02	.15	----	
Class Variable Set (CLS)										
CLS(1)	CLS-Size Grade 12	----								
CLS(2)	CLS-Class Size	.25	----							
CLS(3)	CLS-% Female	-.25	-.36	----						
CLS(4)	CLS-'Drudge' (TA)	.17	.34	-.11	----					
CLS(5)	CLS-Enquiry (TA)	.15	-.16	.11	-.44	----				
CLS(6)	CLS-Hard Core Physics (TA)	.11	.12	-.12	.44	-.34	----			
CLS(7)	CLS-Gen Ed (TA)	-.10	-.20	.11	-.29	.21	-.43	----		
CLS(8)	CLS-Novel (TM)	.18	.15	-.07	-.10	-.06	-.00	.15	----	
Criterion Variable Set (LEI)										
LEI(1)	LEI-Intimacy	----								
LEI(3)	LEI-Cliqueness	-.23	----							
LEI(5)	LEI-Speed	.09	-.02	----						
LEI(6)	LEI-Difficulty	.22	-.18	.58	----					
LEI(8)	LEI-Favoritism	-.04	.33	.19	-.05	----				
LEI(9)	LEI-Formality	.05	-.33	.24	.25	-.07	----			
LEI(10)	LEI-Goal Direction	.17	-.38	-.09	.13	-.33	.30	----		
LEI(12)	LEI-Disorganization	*	*	*	*	*	*	*	*	

of each class were assigned for each instrument, there is no complete set of data for any given individual. However, it is possible to estimate class means and variances for the classroom group component of the model. The original 23 student group variables were reduced to eight. A reasonably small number of measures was desired since the group description requires both mean scores (STU) and variance (VAR) for each variable. The maximum correlation between two variables is 0.34. A principal components factor analysis shows only 18% of the variance attributable to a common factor, and the rotated factor loadings suggest an orthogonal factor space exists which accounts for 96% to 99% of the variance for the individual scales with a maximum cross loading less than 3%. Several new scales were created from highly correlated variables in the original set. The ATTITUDE-Physics scale was generated by taking the mean z-score on AIM-Physical Science and the two semantic differential scales PHYSICS-Interesting, Valuable. The AUTH+ORDER scale was created by taking the mean of z-scores on the POS-Authoritarianism and POS-Need-Order scales. This relationship is reasonable considering the relatively dependent status of high school students. The ACH+AFFIL+CHANGE scale is the mean z-score on the three POS scales NEED-Achivement, NEED-Affiliation and NEED-Change. The strong relationship among these three scales is consistent with Erikson's description of the adolescent search for identity.[13] Finally, the STU-School scale was created by combining all of the items which had been derived from the student questionnaire included in the scales SQ-Leader, Scholar, Opportunity, Achiever. These latter scales related to the student's interest in school, serious study, leadership, etc. and appeared to define a common dimension when considered with other

student descriptors. The new scale also has improved reliability (0.70). Since the VAR variables are determined by the selection of the STU variables, no factor analysis was made of this set.

Class Variable Set (CLS) The initial selection of eight variables to describe the class structure provided a reasonably orthogonal factor structure. The largest correlation between any two scales is 0.44. The principal components analysis shows a maximum of 30% common variance among the scales and the rotated factors suggest an orthogonal factor exists which accounts for 86% to 98% of the individual scale variances with less than 5% cross loading.

The Criterion Variable Set (LEI) Sainte-Marie[14] conducted an extensive factor analytic study of the Learning Environment Inventory (LEI) in an effort to reduce the inter-correlation among a number of the 14 scales. He concluded that nine of the original scales represent a reasonably orthogonal set of classroom climate variables. Seven of the nine appeared relevant to the current study. The Disorganization scale was also included, for although highly correlated with several of the other scales, measures of disorganization have been important in other studies.[1 & 4] The intercorrelations of the LEI scales are somewhat higher for the current sample of classes than for the larger sample studied by Sainte-Marie. The largest intercorrelation is 0.58. The principal component factor analysis showed 32% common variance among the scales, and the rotated factors exhibit an orthogonal factor structure which accounts for 86% to 98% of the individual scale variances with less than 10% cross loading. This structure is not as independent as those of the sets of predictor variables; however, it

is sufficient to allow the use of univariant regression techniques planned for the regression analysis.

The Final Sample

Before proceeding with the regression analysis, several classes with incomplete sets of data were excluded from the study. The remaining 96 classes were randomly divided into a model group (N=72) and a test group (N=24). The larger number of classes was included in the model group because preliminary correlational studies demonstrated a 50-50 split produced rather unstable correlations among the variables between the two groups. Tests of skewness and kurtosis showed nearly all the variables to be reasonable normally distributed and t-tests between the means of the model and test groups were not significant at the $p = 0.05$ level.

The Regression Model

The DATATEXT Program was used for the regression analysis. The choice of variables to be entered for each of the LEI scales was empirically determined by the correlations of each variable with the given LEI scale. A check on the stability of the correlations for the model group was made using a jackknife technique in which five random 80% subsamples of the model group were taken. In general, the correlations were reasonably stable. The regression analysis was terminated when the last variable increased the variance by less than 1%. A summary of the regression analysis is reported in Table III.

Insert Table III about here

The total variance included in each regression equation (R^2_{max}) ranged from 21% (LEI-Formality) to 63% (LEI-Intimacy). Only the most significant variables have been included in the final regression model which reduces somewhat the total variance included in the model (R^2).

A measure of the effectiveness of the regression model may be obtained by comparing R^2 with the Fisher Intraclass Correlation (F_{ic})[15] which is the ratio of the between class variance to the within class variance. The Fisher Intraclass Correlation is a measure of the proportion of the total test variance which represents the true test variance among classes. The ratio R^2/F_{ic} thus provides an indication of the "true" variance which has been accounted for by the regression. Between 40% and 77% of this true test variance has been included in the final model. The regression equations for each of the LEI scales are reported in Table IV.

Insert Table IV about here

A Test of the Regression Model

Since the regression model represents the best least squares fit of the data used to generate the model, it is desirable to test the generalizability of the model with an independent sample of data. Because of the limited number of classes available, a small sample of 24 classes was reserved for the test. Some confounding between the model and test groups was introduced when all available units of

TABLE III - Amount of Variance Included in the Regression Model

Scale	F_{ic}	R^2_{max}	# Vars	R^2_{max}/F_{ic}	R^2	# Vars	R^2/F_{ic}
LEI-Intimacy	.82	.63	7	.77	.57	4	.70
Cliqueness	.77	.34	7	.44	.33	5	.43
Speed	.71	.39	7	.55	.37	5	.52
Difficulty	.84	.54	11	.64	.47	5	.56
Favoritism	.53	.21	3	.40	.21	3	.40
Formality	.82	.51	10	.68	.47	4	.57
Goal Direction	.71	.33	9	.46	.32	8	.45
Disorganization	.82	.52	8	.63	.47	5	.57

TABLE IV - Summary of LEI Regression Analysis

Scale	Coefficient	Std Error	Std Coefficient	p less than	Unique Variance
LEI - Intimacy	α = .78	F_{ic} = .82	R^2 = .57	p < .001	$\hat{R}^2$ = .25
CLS-Size Grade 12	- .452	.08	-.468***	.001	.20
CLS-Class Size	- .292	.08	-.310***	.001	.08
TCH-Theoretical	- .257	.10	-.228**	.01	.05
STU-Aesthetic	- .542	.21	-.215*	.01	.04
Regression Constant	- .292				
LEI - Difficulty	α = .66	F_{ic} = .84	R^2 = .47	p < .001	$\hat{R}^2$ = .22
STU-IQ	.953	.20	.438***	.001	.19
TCH-Authoritarianism	.342	.9	.357***	.001	.12
STU-Attitude Physics	.704	.24	.266**	.005	.07
CLS-Size Grade 12	- .196	.09	-.205*	.03	.04
CLS-Enquiry	- .140	.09	-.152	.1	.02
Regression Constant	.122				
LEI - Formality	α = .64	F_{ic} = .82	R^2 = .47	p < .001	$\hat{R}^2$ = .19
TCH-Aesthetic+Political	- .413	.09	-.427***	.001	.16
TCH-Authoritarianism	.300	.08	.332***	.001	.11
STU-School	- .867	.28	-.286***	.003	.06
CLS-Enquiry	- .141	.08	-.163	.09	.02
Regression Constant	- .029				
LEI - Disorganization	α = .81	F_{ic} = .82	R^2 = .47	p < .001	$\hat{R}^2$ = .31
STU-Aesthetic	.756	.20	.340***	.001	.11
TCH-Aesthetic+Political	.323	.09	.352***	.001	.11
STU-Political	.735	.22	.311**	.002	.09
VAR-Stu Attitude Physics	1.345	.40	.323**	.002	.09
CLS-'Drudge'	- .225	.09	-.248*	.02	.05
Regression Constant	- .739				
LEI - Cliqueness	α = .74	F_{ic} = .77	R^2 = .33	p < .001	$\hat{R}^2$ = .08
STU-Aesthetic	.669	.24	.289**	.007	.08
VAR-Stu Ach+Affil+Change	.799	.35	.235*	.03	.05
STU-Political	.647	.25	.263*	.01	.07
TCH-Ach+Order+Affil	- .263	.13	-.215*	.04	.04
VAR-Stu Theoretical	.882	.44	.214*	.05	.04
Regression Constant	-1.035				
LEI - Speed	α = .77	F_{ic} = .71	R^2 = .37	p < .001	$\hat{R}^2$ = .10
TCH-Authoritarianism	.365	.10	.368***	.001	.13
CLS-Enquiry	- .238	.10	-.250*	.02	.06
VAR-Stu IQ	-1.906	.56	-.352**	.002	.11
VAR-Stu Aesthetic	.971	.46	.217*	.04	.04
STU-IQ	.454	.25	.201	.07	.03
Regression Constant	.928				
LEI - Favoritism	α = .77	F_{ic} = .53	R^2 = .21	p < .002	$\hat{R}^2$ = .09
TCH-Ach+Order+Affil	--.333	.14	-.263*	.02	.07
CLS-'Drudge'	- .241	.11	-.245*	.03	.06
STU-Aesthetic	.560	.26	.233*	.04	.05
Regression Constant	.105				
LEI - Goal Direction	α = .86	F_{ic} = .71	R^2 = .32	p < .002	$\hat{R}^2$ = .02
STU-Aesthetic	- .455	.27	-.215	.10	.03
CLS Size Grade 12	- .132	.09	-.163	.2	.02
STU-Auth+Order	.418	.27	.206	.1	.03
CLS-Enquiry	- .204	.09	-.262*	.02	.06
VAR-Stu Attitude Physics	- .630	.47	-.159	.2	.02
TCH-Social	.200	.11	.256	.07	.04
TCH-Authoritarianism	.151	.10	.185	.1	.03
VAR-Stu Aesthetic	- .535	.44	-.146	.2	.02
Regression Constant	.836				

analysis were used to define the variables used in the study. However, given the limited number of classes available and the current state-of-the-art of this type of research, the procedure appeared reasonable. The proportion of variance predicted in the regression test is indicated by $\hat{R}^2$ in Table IV.

Correlations between the predicted and observed scores are highest for the Intimacy, Difficulty, Formality and Disorganization scales. These scales have several highly significant predictor variables which account for between 50% and 60% of the variance in the model group. About half of the variance accounted for in the model group is also included in the regression test. The scales Cliqueness, Speed, Favoritism, and Goal Direction do not have highly significant predictor variables in the model group and are poorly predicted in the replication.

Discussion

The results of this study suggest that at least four of the LEI classroom climate scales are strongly associated with certain characteristics of teachers, student groups, and class structure variables. However, it is important to bear in mind that the relationships discussed below represent characteristics which are relative to the physics teachers, student groups and classrooms included in the study.

LEI-Intimacy (now called Cohesiveness) This scale is primarily related to students knowing one another and to some degree measures the interaction among students. Structure variables such as the size of the school and the number of students in the class provide the strongest predictors. Classes taught by teachers who score relatively high on the AVL Theoretical scale are perceived as less intimate. It

is hypothesized that these teachers are more content oriented and structure the class in ways which do not facilitate student interaction. This hypothesis is supported by the correlations between TCH-Theoretical and several other variables which show that these teachers are low on Authoritarianism (-.47***)† and tend to have relatively large physics classes (+.31**) comprised mostly of boys (+.28***) who are rather political (+.42***). The teacher subscribes to "Drudge" teaching practices (+.31**), i.e. detailed lab instructions and reports along with much assigned homework and problems, and is not concerned with general education aspects of physics teaching (-.31**).

The fact that classes with a relatively high mean on the AVL-Aesthetic scale tend to be less intimate is probably not causal but is related to the ability of these students to sense inconsistency in the overall classroom climate. The LEI reflects this sensitivity because it relies upon student perception of the classroom climate. This interpretation is supported by the correlations between the STU-Aesthetic scale and several of the other variables. Highly "aesthetic" classes tend to have a poorer attitude toward physics (-.30*) and are composed of bright students (+.31**) who perceive the class as having higher friction (+.24*), cliqueness (+.33**), apathy (+.33**), favoritism (+.26*), and disorganization (+.37**) with less goal direction (-.38**), democracy (-.37**) and satisfaction (-.30**).

LEI-Difficulty Classes with students of high ability who have a positive attitude toward physics are perceived as more difficult.

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† Level of significance of the correlation: * $p < .05$; ** $p < .01$; $p < .001$

This probably reflects formal or informal selection bias which creates classes of "able" students in which peer competition and teacher expectation is greater. Teachers who score relatively high on "Authoritarianism" are also associated with classes perceived as more difficult. The POS-Authoritarianism scale is based on 15 items selected from the California F Scale.[21] The interpretation given this scale by the HPP Evaluation Group was that persons with high authoritarianism scores would be more rigid in their problem-solving behavior, more concrete in their thinking, more narrow in their grasp of a particular subject, and have a greater tendency to be intolerant of ambiguity. An examination of the correlations of this scale suggests that, for this sample of physics teachers, Authoritarianism is related to rather pragmatic, businesslike teacher behavior. The scale is negatively correlated with both the AVL scales Social (-.39***) and Theoretical (-.47***) as well as teaching styles such as "Drudge" (-.43***) which values detailed lab instructions and reports, lots of problems and homework, and lower grades in physics or "Hard Core Physics" (-.40***) which stresses physics as a difficult elite subject requiring good math skills. Teacher authoritarianism is also associated with reduced variation in student attitude toward physics (-31**).

It is interesting that class structure variables other than size of the school were not important predictors of the perceived difficulty. However, this may be the result of the relatively high correlation of many of these variables with TCH-Authoritarianism. It may also be due to the indirect assessment of class structure variables from the teacher questionnaire as opposed to having more direct measures of these process variables.

LEI-Formality Teacher variables are important predictors of the degree to which formal rules guide the behavior of the class. "Authoritarian" teachers tend to have more formal classes as do teachers who value the "Personal power, influence, and renown" associated with the Political scale of the AVL. The fact that classes of students with a high mean on the STU-School variable perceive their classes as having fewer formal rules is consistent with the teacher expectation effect mentioned earlier. Teachers tend to be less strict and more flexible with classes of "good" students.

LEI-Disorganization Although the degree of perceived disorganization of the classroom might be expected to depend primarily upon characteristics of the teacher and classroom structure, the results of this study suggest the importance of a variety of factors which include all components of the classroom model presented in Figure 1. The variables STU-Aesthetic and TCH-Aesthetic+Political have been discussed previously so we shall simply note that the direction of the association is as expected. Classroom groups comprised of many individuals who value the "personal power and influence" associated with AVL Political scale or which have large variation in student attitude toward physics might provide a less satisfying social climate. The resulting lack of esprit de corps would make it more difficult for students to help one another minimize confusion and make progress. This hypothesis is supported in that variation in student attitude toward physics is associated with the perception of increased friction (0.37**) and apathy (.50***) and decreased satisfaction (-.40***). Likewise STU-Political is associated with increased friction (.34**) and apathy (.25*) as well as decreased intimacy (-.27*) and satisfaction (-.32**). The fact

that the classroom structure variable CIS-'Drudge' is negatively associated with perceived disorganization is consistent with the description of the scale which includes explicit lab directions with detailed reports and lots of assigned problems and homework.

Conclusions

The classroom groups included in this study represented a true national random sample of physics classes in the United States. Although studying naturally occuring classroom groups allows some confidence in generalizing the associative relationships, the probable selection biases which influence the formation of these groups seriously impairs efforts to determine causal relationships which would be valuable for guiding teaching. For example, classes with a relatively high proportion of females tend to be perceived as more intimate (.35**), satisfying (.35**) and democratic (.25*) with less friction (-.31**) and apathy (-.51***). However, it is uncertain whether the presence of women in these classes produces these desirable outcomes or whether classes with a reputation for these characteristics tend to attract more women. While associative studies are valuable for identifying potentially significant characteristics which can be manipulated by educators, careful experimental studies must follow before specific recommendations for practice can be responsibly made.

Synopsis

The purpose of the current study was to predict selected scales in Anderson's Learning Environment Inventory (LEI)[1] from data describing teachers, students and their respective classrooms which has been gathered for the Harvard Project Physics (HPP) summative evaluation (1967-68)[2]. The HPP data represents a true national random sample of 54 physics teachers with 3085 students in 103 classes[3] which allows some confidence in generalizing the results to the universe of physics teachers and classes in the United States. Regression analysis of the eight selected scales accounted for 21% to 63% of the variance for the model group of 72 classes. A replication based on 24 classes supported the regression model for the LEI scales Intimacy, Difficulty, Formality, and Disorganization.

Footnotes

[1]Anderson, Gary. The Assessment of Learning Environments: A Manual for the Learning Environment Inventory and the My Class Inventory. Halifax, Nova Scotia: Atlantic Institute of Education, 1973. (Price $5.00)

[2]Welch, Wayne, "Review of the Research and Evaluation Program of Harvard Project Physics," Journal of Research in Science Teaching, V.10, n. 4 (1973), pp. 365-378

[3]Welch, Wayne and Herbert J. Walberg, "A Design for Curriculum Evaluation," Science Education, V. 52 (1968)

[4]Ryans, David G. Characteristics of Teachers. Washington, D.C.: The American Council on Education, 1960.

[5]Main, Cecil and Paul B. Hounshell, "A Comparative Study of Personality and Behavior of Science and Non-science Teachers," Journal of Research in Science Teaching, V. 10, n. 2 (1973)

[6]Blankenship, J.W. An Analysis of Certain Characteristics of Biology Teachers in Relation to Their Reactions to the BSCS Biology Program. Unpublished Doctor's Thesis. Austin, Texas: University of Texas 1964.

[7]Sadler, Paul M., "Teacher Personality Characteristics and Attitudes Concerning PSSC Physics." Journal of Research in Science Teaching, V. 5, n. 1 (1968)

[8]Handley, Herbert M. and Joseph C. Bledsoe, "The Personality Profiles of Influential Science Teachers, Regular Science Teachers, and Science Research Students," Journal of Research in Science Teaching, V. 5 (1967-68).

[9]Walberg, Herbert J., "Teacher Personality and Classroom Climate," Psychology in the Schools, V. 5 (1968).

[10]Walberg, Herbert J. and Wayne W. Welch, "Personality Characteristics of Innovative Physics Teachers," Journal of Creative Behavior, V. 1 (1967).

[11]Walberg, Herbert J. and Wayne W. Welch, "Dimensions of Personality in Selected Physics Teachers," Journal of Research in Science Teaching, V. 5 (1967-68).

[12]Bates, Gary. Predicting Learning Environments from Teacher and Student Personality. Unpublished Doctor's Thesis. Cambridge, Mass.: Harvard University, 1974.

[13]Erikson, Erik. Identity: Youth and Crisis. New York: W.W. Norton & Co., 1968.

[14]Sainte-Marie, Louis. Effects of a Flexible Approach to High School Physics on Classroom Climate. Unpublished Doctor's Thesis. Cambridge, Mass.: Harvard University, 1972.

[15]Fisher, R.A. Statistical Methods for Research Workers. London: Oliver and Boyd, 1954.

[16]Geis, Fred Jr. The Semantic Differential Technique as a Means of Evaluating Changes in Affect. Unpublished Doctor's Thesis. Cambridge, Mass.: Harvard University, 1969.

[17]Halpern, Gerald. Scale Properties of the Interest Index. Princeton, N.J.: Educational Testing Service, 1965.

[18]Cooley, W.W. and H.B. Read, "The Measurement of Science Interests: An Operational and Multidimensional Approach," Science Education, V. 45 (1961)

[19]Rokeach, Milton. The Open and Closed Mind. New York: Basic Books, Inc., 1960.

[20]Gough, Harrison G. California Psychological Inventory. Palo Alto, Calif.: Consulting Psychology Press, Inc., 1956.

[21]Adonno, T.W., E. Frenkel-Brunswick, D.J. Levinson, and R.N. Sanford. The Authoritarian Personality. New York: Harper Brothers, 1950.

[22]Edwards, Allen L. Edwards Personal Preference Schedule. New York: The Psychological Corporation, 1953.

[23]Edwards, Allen L. Personal Preference Schedule Manual. New York: The Psychological Corporation, 1959.